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1 4. LEVEE REMOVAL AND SETBACK - [HIGH]

- Principles are supported by Restore Channel Cross-section.
- Discuss considerations for levee removal versus levee setback
- Includes effect of levee removal that has been in place for decades and the channel has tried to evolve to it. (How has the stream evolved to the on-going presence of the levee, and how does the stream's current condition affect expectations for restoration?) Include how the floodplain is treated, risks of simple removal, and sequence of floodplain and channel restoration. Address the potential for detrimental effects of levee removal. Address how far back a levee has to go?
- For all habitats.

1.1 Introduction

1.1.1 Description of Technique

Define levee
Describe various types of levees – I don't know of a full list but it might include confinement (parallel and along river), perimeter (around infrastructure), cross (across the floodplain), set-back, tidal, and estuarine (tidal with freshwater inflow). Focus of this section will be removal or relocation of confinement levees. Floodplain flow spreaders are discussed in ISPG. They disperse flow that is in the floodplain and do not control the quantity or location of flow that leaves the channel.
Define technique as either remove, set back away from channel, or breaching with a channel or culvert

1.1.2 Physical and Biological Effects

Physical effects:

- Change in flood stage and associated change in energy within channel
- Reduces water surface elevation of flood stages
- Allows for over bank flow and may result in associated change in groundwater below floodplain
- Reduces flood potential to downstream
- May reduce upstream water surface elevations during flood flow
- May attenuate sediment transport downstream by providing sediment storage
- May provide greater channel complexity and/or increased shoreline length
- May stabilize channel reach from chronic erosion or unstable deposition
- Changes in channel geometry

Biological effects

- promotes riparian corridor and riparian function and all associated benefits including shade, wood recruitment supply, organic material supply

- allows for flood-flow refuge from high velocities
- may reduce fine sediment in channel and downstream including estuary filling by providing overbank storage for fines
- stability of channel bed and spawning – refer to Dungeness River. Survival of eggs in river is very low. Likely due to confinement of levee.
- Allows access into tributaries

1.1.3 Application of Technique

- Apply to any channel that has levee on or near bank – what sites would be most benefited by levee removal? More detail is provided in the Assessment section below.
- Floodplain development may limit opportunity
- Use in combination with other techniques. Channel realignment, preservation, Riparian and floodplain vegetation, side channels - Potentially start floodplain restoration years before levee removal

1.2 Scale

Discuss how this technique can range in terms of scale, and whether additional specialized expertise (such as a licensed engineer) may be required (or at least advised).

Stream versus large river

Local scale: can punch hole in levee or install a culvert to allow flood storage and create refuge on limited basis
Reach scale: remove or setback levee to promote reach-scale natural process

1.3 Risk and Uncertainty

- Many levees provide bank stability – risk to property in reducing bank hardness has to be addressed
- Little or no uncertainty of hydraulic effect – can be adequately modeled to predict response and effects
- Flood risk can/should be minimal with proper planning
- Risk of removing levee from a channel that has evolved to the levee – there may be risk and uncertainty here; need a clear understanding of how the channel has responded to the levee and what the response will be to the removal

1.4 Data Collection and Assessment

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Data collection:

- Hydrology
- Topographic survey
- Cross-sections and section characteristics sufficient for 1D modeling
- Land use, property ownership, infrastructure at risk
- Sediment transport characteristics

Assessment:

- Assess habitat benefit of specific levee removal in terms of specific biological effects that were generally described previously.
- Hydraulic modeling of impacts to river stage during high flow
- Sediment transport analysis
- Quantified risk to infrastructure (i.e., roads and bridges) located downstream
- For levee removal, some form of channel migration hazard study may be needed for establishing potential migration risk (low, medium, high) (this is more likely an issue on medium- and large-sized rivers)
- Evaluate upstream and downstream effects of levee removal/setback
- Evaluate how stream has responded to the levee over time, and possible secondary restoration activities such as grade control, realignment of channel, and/or revegetation efforts.
- Assess value of various levels of set-back based on channel-floodplain hydraulics, longevity of sediment storage, and channel migration zone.

1.5 Methods and Design

Design process:

1. define objectives
2. develop topographic maps and hydraulic model of existing condition
3. model various scenarios of removal, set-back, etc. including set-back distances in terms of sediment storage, flood storage, flood stage, and channel migration
4. engineering design for set-back levee, including rock toe
5. bank design as necessary to repair disturbance to banks

1.6 Project Implementation

1.6.1 Permitting

- Flood profile impact
- Construction related permitting – sediment control, spill response, etc.
- Reclamation plan for disturbance

1.6.2 Construction

May require special equipment for operating on soft ground – tracked trucks, excavators, etc.

1.6.2.1 Levee removal

- Equipment for excavate and haul
- Repository for fill
- Reclaim disturbance

1.6.2.2 Levee Set-Back

- Equipment for excavate and haul
- Repository for fill
- Reclaim disturbance
- Construction of set-back

1.6.3 Cost Estimation

- Cost estimation is dependent upon earth moving costs – determined by equipment used, access, location.
- Costs for removal and haul to nearby location by cubic yard are:
- Cost to construct levee are:

1.6.4 Monitoring and Tracking

- Photo points
- River stage recorder
- Monitor reclamation to ensure proper recovery
- For set-backs, develop monitoring plan for structural integrity

1.6.5 Contracting Considerations

- No special considerations.

1.7 Operations and Maintenance

- Operations include ensuring success in reclamation
- Maintenance according to objectives and monitoring

1.8 Examples

Canyon Creek feasibility in Whatcom County – intended levee removal

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1.9 References

References cited in this technique so it is a stand-alone pullout.

1.10 Photo and Drawing File Names

List filenames and file locations of any photos and drawing files associated with this technique